

SCIENCE.

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THE LOWEST OF THE VERTEBRATES AND THEIR ORIGIN.*

IN many seas have been found—and in almost all temperate and tropical seas may

* *Columbia University Biological Series. II. Amphioxus and the Ancestry of the Vertebrates.* By ARTHUR WILLEY, B. Sc., Tutor in Biology, Columbia College.

be found—small animals of peculiar appearance and habits and of extraordinary interest. They have a translucent, compressed and elongated fusiform body attenuated at both ends, and therefore have received one of their names—*Amphioxus*; this form may be superficially modified, however, by the development of a membrane around the caudal portion of the body and the extension downwards of cirri from an oral ring. The existence of these cirri and the erroneous attribution to them of a respiratory function have given rise to another name for the group—*Branchiostoma*. *Lancelet* is a semi-popular equivalent of *Branchiostoma* and *Amphioxus*.

The animals thus distinguished externally are unique in their organization. The nervous system is manifest in an elongated tube without any expansion forwards into an externally specialized brain, and with its anterior portion only distinguished by the fact that there are (in front of the first myotome) two symmetrical pairs of sensory nerves which innervate the snout and have no corresponding ventral roots. A skeleton is represented by a simple notochord extending to both ends of the body, and there is no rudiment of a cerebral case or of sense capsules; the only other hard parts are developed around the anterior aperture, where

With a preface by HENRY FAIRFIELD OSBORN. Macmillan & Co. 1894. 8vo, xiv+316. Frontispiece. \$2.50.

a ring is formed by a number of subcartilaginous segments, which give rise to as many processes for the support of cirri just before their posterior ends, which connect with the succeeding segments. A specialized heart is also wanting, and so likewise are paired eyes, as well as auditory and olfactory organs. The sense of sight or light is subserved imperfectly by a median 'eye spot' sessile on the forward end of the nerve tube between the foremost pair of nerves. Immediately behind the eye spot is 'a small pit in the body-wall, reaching from the outer surface of the body to the anterior wall of the brain. This is known as *Kölliker's olfactory pit*, after its discoverer' (p. 19). Every other feature of the organization of the animals in question is noteworthy, and Mr. Willey tells about them in detail in the work which is here noticed, and to that reference may be made for further information.

The species of Lancelets are few; only nine or ten at most are known. They are of small size, ranging from about half an inch to little more than three inches in length. Most of them are found along sandy shores and are prone to bury almost the entire 'body in the sand, leaving only the mouth with the expanded buccal cirri protruding' (p. 9). Nevertheless one specimen was described in 1889 in the 'Report on the pelagic fishes' of the Challenger Expedition (p. 43), and affirmed to have been taken 'a few degrees north of Honolulu,' from 'a deep haul 1,000 fathoms' of an open-mouthed dredge.

Diverse are the views that have been held respecting the affinities of the Lancelets. From a single small specimen obtained on the Cornish coast, Pallas in seven lines described the species in 1774* (not 1778, as Mr. Willey states) and called it *Limax lanceolatus* or *lanceolaris*. Under the

name *Limax*, Pallas included naked gastropods, whether broad or narrow, having a flat foot, and he mistook the metapleural folds and intermediate area of the new species for a foot. No further notice was taken of the species till 1834, when Costa described it anew as *Branchiostoma lubricum*, and in 1836 Yarrell redescribed it, and, with the assistance of John Edward Gray, identified it with the long-neglected *Limax* of Pallas and called it *Amphioxus lanceolatus*.

Both Costa and Yarrell thought that it belonged with the Lampreys and Hags. J. Müller first recognized how important were its peculiarities and in 1844 gave it subclass rank. Isidore Geoffroy St. Hilaire in 1852 and C. Bonaparte in 1856 first elevated it to class rank. Haeckel in 1866 advanced still further and contrasted the class of lancelets as a subphylum (Acrania) with all the other vertebrates (Craniota). This last view is adopted by Mr. Willey who however prefers the later name, Cephalochorda, for the 'division.' The family name, *Branchiostomidae*, was first given by Bonaparte in 1846.

With so much interest attached to them, the lancelets naturally have received much attention, and many elaborate memoirs on various parts of their structure have been published. Of the 140 (133 + 7) titles recorded by Mr. Willey in his bibliographical 'references' (pp. 295—309), 66 are under the head 'Anatomy of Amphioxus,' and 37 under the caption 'Development of Amphioxus.' Mr. Willey very properly adds that "this bibliography does not by any means include all that has been written on the anatomy of Amphioxus." Indeed, the titles could be more than doubled, but without material advantage to the value of the work for most readers. Really Mr. Willey has prepared a very useful and well made list and mainly with well considered restrictions. In view of such an abundant literature the need for a general work embodying

*Spicilegia Zoologica [etc.]. Fasciculus decimus. Berolini [etc.], 1774. (p. 19, pl. 1., fig. 2.)

the most important data respecting the lancelets was urgent. Mr. Willey's volume to a very large extent administers to this need. He has judiciously combined the observations of himself and others and classified them under (I.) 'Anatomy of Amphioxus' and (II.) 'Development of Amphioxus;' under the former caption, he has data 'Historical,' on 'Habits and Distribution,' 'External Form,' and 'Internal Anatomy;' under the latter he treats of the 'Embryonic Development' and 'Larval Development,' enunciates certain 'General Considerations,' and concludes with a comparison of 'Amphioxus and Ammocœtes.' We need only refer specially to the section on 'The Excretory System' (pp. 55-75), because it contains information on 'organs' which were long undiscovered, or at least not appreciated. Mr. Willey is 'convinced as to the essential identity of the excretory tubules of Amphioxus with the pronephros of the craniate vertebrates.' The information respecting other structural features are up to date and the inferences as to homologies and functions reasonable and judicious, although there may be occasion sometimes (but rarely) for dissent. But we could have wished that the radical differences between the lancelets and true fishes had been emphasized by the use of terms indicating that analogous parts were not homologous. For instance, Mr. Willey correctly states that there is a dorsal fin 'supported by a series of gelatinous *fin-rays*, each of which lies in a chamber of its own,' and further says that 'the ventral portion of the fin in the region between atriopore and anus is supported by a similar series of fin-rays, but there are two of them placed side by side in each compartment.' Such structures are very unlike the specialized rays of teleostomous fishes, and to avoid the misleading tendency of such terms it has been recently proposed to designate the so-called rays of the lancelets *actinomimes* and their

inclosing chambers *actinodomes*, while the compound ventral fin has been designated as the *sympodium*. Such terms will be useful in systematic zoölogy as well as morphology.

The ground is now prepared for further advance, and one of the first of the problems that need examination is the amount of variability among the Branchiostomids. The first preliminary is the differentiation of known variation into generic and specific characters, instead of confounding all under one generic name, as Mr. Willey has done.

Applying the mode of valuation current for the higher groups, we have several modifications of different systems that are available for genera. Such are the development of the hinder end, the unilaterality or bilaterality of the gonads or sexual organs, the coördinate development of the metapleural folds, the presence or absence of a sympodium, and the development of the dorsal fin, and especially the relative extent of the actinomimes and actinodomes. Variations in these structures are expressible under five generic terms already named, *Branchiostoma*, *Paramphioxus*, *Epigonichthys*, *Asymmetron* and *Amphioxides*. Two of the genera (*Paramphioxus* and *Epigonichthys*) have recently been combined in one to which the new name *Heteropleuron* has been given, but even if such a union is favored, *Epigonichthys* should be used as the first distinctive name given to a member of the group; the two, however, appear to be sufficiently distinguished by the fins. *Epigonichthys* has an unusually high dorsal membrane and contracted actinomimes.

Eight species of lancelets are recognized by Willey, as had been previously by Dr. E. A. Andrews; one described in 1889 ('*B. pelagicum*') was overlooked and another (*Paramphioxus Singalensis* or *Heteropleuron Singalense*) has been described since.*

*On the species of Amphioxus. By J. W. Kirkaldy. Rep. Brit. Ass. Adv. Sc., 1894, pp. 625-686.

These have been simply distinguished by Mr. Willey by the number of myotomes, but most of them may be distinguished by other characters. Of the ten species, five belong to *Branchiostoma*, two to *Paramphioxus*, one to *Epigonichthys*, one to *Asymmetron*, and one to *Amphioxides*.

What are specific characters in any Branchiostomoid genus is a question as yet undetermined. The only one that has been generally used (exclusive of what are rather of generic importance) is the number of myotomes as a whole and in different regions. Even such a character has not been constantly adhered to. For example, in Dr. E. A. Andrews' useful and able memoir on 'An Undescribed Acraniate' two eastern American species are recognized, '*B. lanceolatum*' and '*B. caribæum*.' The former has an average of $(35.6+13.6+11.8=)$ 61 myotomes, and the latter an average of $(34.8+14+8.9=)$ 57.8 myotomes, but one individual from the Chesapeake Bay, referred to '*B. lanceolatum*,' has $(36+16+7=)$ 59 myotomes, and another Florida, referred to '*B. caribæum*,' has $(35+17+7=)$ 59 myotomes. Inasmuch as no other differential characters have been given, it is evident that Dr. Andrews was mainly influenced by the consideration of association or geographical distribution rather than morphological characters in the identification of the different specimens. The relations of the forms of our coast, indeed, still remain to be determined, and it is doubtful whether any American forms will prove to be conspecific with the European. Specific characters may perhaps be found in numerous details, *e. g.*, the number and proportions of the dorsal and ventral or sym-podial rays, the development of the cirri and skeletal bases; details of the velar tentacles and gillbars, form of the caudal, relative proportions of the various regions, etc. But numerous as have been the memoirs on *Branchiostoma lanceolatum*, no de-

tailed study of variations has yet been published. Until this is done much is left undone. The material now in museums, however, is generally insufficient for such studies and should be especially prepared therefore. If the labor of students, so often frittered away in verifying oft-repeated observations, could be in part directed to such preparation and observation, a boon to systematic zoölogy would be realized and certainly no less would be the benefit to the student. We may hope that Mr. Willey will continue studies so well begun and enlighten us on some of the many points still obscure. That we are ignorant as to the questions in point is not his fault.

The ancestry of the vertebrates is a fascinating subject for consideration, and the search for their nearest relatives began early in the century. Before the lancelet was known—at least as a vertebrate—Etienne Geoffroy Saint-Hilaire endeavored to homologize constituents of the bodies of insects and vertebrates. (We may here remark that Mr. Willey has repeatedly referred to the French naturalist as Saint Hilaire, but Saint Hilaire was only an agnomen, the true cognomen or family name being Geoffroy.) Long after the lancelet had been carefully investigated, and indeed very recently, a naturalist trained in modern methods, but who did not exercise a 'scientific use of the imagination,' actually contended that the vertebrates had arachnoid or rather limuloid ancestors! A less extravagant view has been that Annelid worms were nearest of kin to the vertebrate ancestors, and this has gained several followers. But the highly specialized character of annelids and still more of arthropods appears to forbid the serious consideration of such conceptions. Much more probable is the view that the nearest relatives of typical vertebrates are the Tunicates. This is the idea adopted by Mr. Willey, who has accepted a 'group' called 'Proto-

chordata' and included thereunder three divisions, (1) HEMICHORDA, or *Balanoglossids*, *Cephalodiscids* and *Rhabdopleurids*; (2) UROCHORDA, or *Ascidians*, and (3) CEPHALOCHORDA, or *Lancelets*. It is the present fashion to consider this affiliation as established, but it has not been proven beyond cavil. As a provisional hypothesis, however, it is the best of those that have been proposed, and there is no need to offer here any objections. Nevertheless, we should recall the fact that the lancelets and all other so-called 'Protochordata' must have very widely diverged from their common ancestors and that some of the characteristics of the first are probably the result of degeneration. When, for example, we find a specialized heart and auditory organs in Tunicates, as well as in many true invertebrates (even though they be not homologous), it is difficult to resist the inference that their absence in the lancelets is due to loss rather than to original failure of development. But now, with the necessary precautions and much hesitancy, we may assent to the possibility of the conclusions with which Mr. Willey closes his work.

"For the present we may conclude that the proximate ancestor of the Vertebrates was a free-swimming animal intermediate between the Ascidian tadpole and *Amphioxus*, possessing the dorsal mouth, hypophysis, and restricted notochord of the former; and the myotomes, coelomic epithelium, and straight alimentary canal of the latter. The ultimate or primordial ancestor of the Vertebrates [or Chordates] would, on the contrary, be a worm-like animal whose organisation was approximately on a level with that of the bilateral ancestors of the Echinoderms."

The length to which this notice has already extended forbids attention to various other features of Mr. Willey's work. It must suffice to add that the fourth and fifth sections are devoted respectively to 'the Ascidians'

(pp. 180-241) and 'the Protochordata in their relation to the problem of vertebrate descent' (pp. 242-293). For these we owe further thanks, and for all we feel assured future students of the groups in question will be grateful.

THEO. GILL.

SMITHSONIAN INSTITUTION.

CURRENT NOTES ON ANTHROPOLOGY (IX). THE RITUAL CALENDAR OF CENTRAL AMERICA.

In the *Globus*, No. 18, 1895, Dr. E. Förstemann has one of his ingenious studies of the Central American Calendar, this time that portion of it called by the Nahuas the *Tonalamatl*, or Book of Days. This consisted of a period of 260 days, and strenuous efforts have been made by Mrs. Zelia Nuttall and other writers to treat it as a time-count, that is, as an aliquot part of the computation of astronomical years and cycles.

In this article Dr. Förstemann shows that this certainly does not hold good for the *Tonalamatl* as it constantly recurs in the Mayan manuscripts. In them it appears to be introduced for exclusively divinatory purposes, a basis for predicting events relating to persons or tribes, or else the weather, wars, disasters, etc. Not unfrequently a multiple of the period is embraced in the forecast, and very generally reference is made to the divinities assigned to the subdivisions of the *Tonalamatl*. Or, again, it is occasionally divided into its fourths, fifths or tenths; and what is noteworthy, the manuscripts present numerous similarities in these respects, proving that their writers were working on a like system of horoscopy.

I may add that the result of this investigation corroborates the position that I took in my 'Native Calendar of Central America and Mexico' (Phila. 1893), in which I maintained that the *Tonalamatl* was invented for and practically exclusively applied to divination, and not to the cyclical measure of astronomical time.

THE TREE AND THE CONE.

EVERY one who has given the least attention to works on ancient Assyria is familiar with the engraving which shows a winged deity, holding in one hand a small basket or bucket, and in the other something like a pine cone, which he is generally presenting toward a tree. This used to be construed as the 'cherub' offering the cone, a symbol of reproduction, etc., to the 'sacred tree' of Babylonian mythology.

A few years ago Dr. E. B. Tylor advanced the explanation that the true meaning is a representation of the fertilization of the female date palm, artificially, by the agriculturist impregnating its flowers with the inflorescence of the male tree. This was at once accepted by many writers, while others withheld their assent, asking why a winged cherub instead of a mortal should be depicted; and still further pointing out that this same ceremony is not rarely shown where there is no tree at all, but, say, the gate of a city, or some exalted personage, like a king.

These arguments have been repeated with emphasis by Dr. E. Bonavia in his recent work, 'The Flora of the Assyrian Monuments' (London 1894). He shows that the bucket or basket is certainly a *bucket*, intended for fluids, and inappropriate to carrying flowers. He offers the very plausible theory that it was designed to contain holy water, and the cone was an *aspergillum*, as it still is in the East. The winged cherub is the rain-bringer typified, etc.

This is far the most satisfactory interpretation which has yet been offered, and allies itself closely with numerous rites and myths of ancient Mesopotamia.

NATIONAL VERSUS INDIVIDUAL DEVELOPMENT.

THE French have a knack of putting their conclusions in an aphoristic form, which, whether they are right or wrong, impresses

the mind. An example is the following from a memoir by M. Dumont, published by the Paris Society of Anthropology last year:

"The increase of a nation in numbers is in inverse ratio to the efforts of its individual members toward personal development."

Now, if this is true, it means the discovery of a momentous law in sociology, which, among other consequences, will do away with all fears of over-population in free and enlightened states. Its corollaries would also dismiss both the dread of socialism and likewise of unscrupulous individualism, which two are the Scylla and Charybdis of modern political economists.

Of course, 'efforts toward personal development' must be construed as sensible and properly directed efforts towards a development which is really such, according to the highest criteria we now have. The reasons why such efforts would necessarily limit the numerical increase of a nation are evident enough. Whether these in the long run might not work as badly as the *laissez faire*, or 'go as you please' policy, is the question underlying this sociological puzzle.

THE SOURCES OF PERUVIAN CIVILIZATION.

In a paper in the Denison Quarterly, Vol. III., Dr. George A. Dorsey discusses 'The Character and Antiquity of Peruvian Civilization.'

He is inclined to assign it a greater age than has usually been allowed it. He would place its earlier periods contemporaneous with 'the golden age of Greece, or when the people of the Nile valley were in the zenith of their power.'

Generally, the historic or even the traditional cycles of the Quichuas are not supposed to carry us beyond about 1000 A. D. One historian, Montesinos, who names dynasties far more remote than this, has been

generally discredited, though he claimed native sources for them; and it is fair to add that we have no positive certainty how great the value of the mnemonic system of the Quichuas, their knotted and colored cords, the *quipus*, may have been. It has also been more than once argued that there must have occurred important modifications in climate since the great temples and cities on the cold plateaus were built, and harbored the large populations which must have dwelt in them. This would require a long period.

As Dr. Dorsey speaks from personal observations and extensive archæological explorations in Peru, his opinion, however at variance with that usually entertained, merits careful consideration.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

CURRENT NOTES ON PHYSIOGRAPHY (IX.)

THE GLACIAL ORIGIN OF LAKE BASINS.

AS LONG as lakes are regarded simply as locally deepened valleys, their explanation by glacial erosion may be fairly maintained; for when the problem is thus vaguely stated, the requirements to be met by the theory are so simple that the hypothesis of glacial erosion finds perhaps better reasons for acceptance than any other hypothesis. But as the facts to be explained are more carefully observed, they generally become more highly specialized and more peculiarly correlated; and their glacial origin may then be either confirmed or excluded. The peculiar association of features described by Lincoln (*Amer. Jour. Sci.*, xliv., 1892, 290) and by Tarr (*Bull. Geol. Soc. Amer.*, v., 1894, 339), regarding Cayuga Lake, seems on the one hand to demonstrate the glacial excavation of this basin; but, on the other hand, the extraordinary correlation of facts determined by various observers around Lake Zurich does not seem to be within reach of explanation by so simple a process

as glacial erosion. In spite of so good a general argument for the competence of ice action as has been presented by Bohm (*Verein zur Verbreit. Naturw. Kenntnisse in Wien*, xxxi., 1891, 477), and in spite of the emphatic disapproval by J. Geikie of various other processes that have been suggested for the production of Alpine lakes (*Great Ice Age*, 3d ed., ch. xix.), the origin of Lake Zurich is certainly not to be accounted for by generalizations at a distance, but only by a special process that will fit all the facts found on the ground. Evidence tending to this end has gradually been accumulating for a number of years; but at an accelerated rate since Heim and Bodmer interpreted the meaning of the rock terraces on the valley sides, and since Penck, DuPasquier and others deciphered the records of the several glacial epochs on the north slope of the Alps.

THE ORIGIN OF LAKE ZURICH.

THE problem of Lake Zurich is presented in a masterful manner by Aeppli in the thirty-fourth number of the *Beiträge zur Geologischen Karte der Schweiz*, in brief as follows: The valley of the Limmat, in which the lake lies, was eroded in broad upland over which the *Deckenschotter* of the first glacial epoch had been previously spread. That the erosion of the valley was performed in the normal fashion by weather and water, and not by ice, is shown by the graded terraces or rock benches, traceable more or less continuously along its sides; these terraces being independent of rock structure, and associated with similar terraces in other valleys, all leading agreeably to the conclusion that after the first glacial epoch the region was generally elevated and the streams thereby given increased power of erosion. The *Deckenschotter*, where preserved on the ridges between the adjacent valleys, together with the terraces on the valley slopes, are bent backwards across a belt six

or eight kilometers broad, so as to slope *towards* instead of *from* the Alps; and the deformation of the *Deckenschotter* and of the earlier higher terraces is greater than that of the lower and younger terraces, thus proving the progressive action of the deforming forces. Associated with this change, there was a general depression of the *Molasse* belt, between the Jura and the Alps, and in the depressed part of the valley of the Limmat, thus generally outlined by the latter process and locally deepened by the former process, the lake had its birth. The belt in which the terraces are deformed crosses the valley somewhat obliquely, but runs parallel to the strike of the general Alpine deformations of the region. Into the lake thus formed, the glaciers of the second and third epochs advanced; but they exercised so little destructive power that they did not obliterate the terraces on the valley sides. The lateral moraines of the last epoch are distinctly discordant with the terraces; the moraines reaching successively higher and higher terraces up-stream, and crossing the belt of deformation without indication of disturbance. Outside of the several terminal moraines, the former lower end of the lake received the valley gravels that were washed from the ice. Hence while the later glaciers may have acted to some degree in altering the form of the lake, their chief effect was to diminish its size by supplying plentiful gravels from the inner Alps, with which a part of the lake basin that they entered was filled.

TARNS OF THE ENGLISH LAKE DISTRICT.

J. E. MARR has examined the tarns or smaller lakes of the mountainous district of northwest England, and finds that their reputed dependence on rock basins is not justified by local study. They appear to result from drift obstructions, by which their outlets have been turned to one side of the former valley troughs and detained in dis-

charging the lakes by settling on rock ledges. In many cases lakes of similar origin have been converted into meadows when their outlets did not depart greatly from the former valley line, and hence encountered only drift in trenching new discharging channels (Quart. Jour. [London] Geol. Soc., li., 1895, 35-48). This does not bear so much on the general question of glacial erosion as on the particular question of the ability of glaciers to form basins by local erosion in excess of their general action along their floor.

THE REGION ABOUT MUNICH.

IN celebration of its twenty-fifth anniversary, the Geographical Society of Munich has issued a handsome volume of 440 pages, containing a number of essays by Günther, Ratzel, Penck and others. Ratzel makes the coast line of Maine 4,300 miles in actual length; though a direct line from Eastport to Kittery measures only about 200 miles. The essay most likely to interest American readers is on the geology of the region about Munich by Ammon, illustrated with a geological map, plate and cuts. It may serve as a guide to excursions from this attractive center; from few other points can so many phases of piedmont glacial geology and geography be seen to so good advantage. Würm and Ammer lakes lie twenty odd miles to the southwest, enclosed by the younger morainic belt. Older moraines stretch farther out from on the plain, especially to the east of the city; and beyond them are spread the flat confluent gravel fans that are associated with various epochs of ice advance. On the sloping plain stands Munich, and across it the Isar and the Amper have trenched their new valleys. The illustrations of morainic topography are very characteristic. A good bibliography accompanies the article; while on an earlier page, Simonsfeld contributes a thirty-page *Bibliotheca geographica bavariae*.

HARVARD UNIVERSITY.

W. M. DAVIS.

SCIENCE IN CANADA.

THE CANADIAN ROYAL SOCIETY'S ANNUAL MEETING.

THE annual meeting of the Royal Society of Canada opened at Ottawa on the 14th ult. and closed on the 17th. Mr. J. M. Le Moine, the well known historian and friend of Parkman, presided. This institution, which was founded in 1882 by the Marquis of Lorne, then Governor-General of Canada, consists of four sections, of which two are entirely scientific—the third being devoted to the mathematical, physical and chemical sciences; the fourth to the geological and biological sciences. The first and second have also a scientific element, for though nominally set apart for English and French literature, respectively, they admit, under the head of archæology a class of subjects that are not unrelated to important branches of science. During the recent session, for instance, three papers of a scientific character were presented in the second section: 'The present position of American Anthropology,' by Professor John Campbell, LL. D., of Montreal; 'Religion and Aerolites,' by Mr. Arthur Harvey; and 'An Iroquois Condoling Council,' by the venerable ethnologist, Mr. Horatio Hale. Those who are acquainted with Mr. Hale's excellent monograph, 'The Iroquois Book of Rites,' in Dr. Brinton's 'Library of Aboriginal American Literature,' will not be entire strangers to the subject of Mr. Hale's paper.

Of the papers of the scientific sections, the first read in Section 3 was the presidential address of Dr. Harrington (McGill College), which dealt with a subject of considerable interest. Professor Harrington urged the necessity of using absolutely pure materials in chemical operations where the object was to establish formulæ. The address, which was illustrated by abundant examples, gave rise to an interesting discussion, in which Mr. T. Macfarlane, chief analyst

of the Dominion; Professor Goodwin, of Kingston, Ont., and Dr. Ells, of Toronto, took part. Professor Harrington also read a paper on 'The Chemical Composition of Andradite from two localities in Ontario.' It gave the results of the examination of a black garnet, occurring in association with the magnetic iron ore of the Paxton mine, Lutterworth, Ont., and of a brown andradite present in the nepheline syenite of Dungannon, Ont. Of these andradites the former was found to be free from titanium, the latter to be titaniferous.

Other papers read in Section 3 were the following: 'A short essay on an attempt to measure the relative easterly and westerly transmission lines through an Atlantic cable,' by Professor C. H. McLeod (McGill College); 'On the estimation of Starch,' by Mr. Thos. Macfarlane, Ottawa; 'Viscosity in Liquids and Instruments for its Measurement,' by Mr. Anthony McGill; 'Periodicity of Aerolites,' by Mr. Arthur Harvey, Toronto; 'On Some Applications of De Moivre's Formulæ,' by Professor F. N. Dupuis, Queen's College, Kingston, Ont.; 'On the Hypotheses of Dynamics,' by Professor McGregor, of Dalhousie College, Halifax. In a former paper Professor McGregor had tried to express the ordinary hypotheses employed in dynamics in a form suited to the conception of bodies as consisting of particles acting upon one another at a distance. In the later paper he endeavors to express those hypotheses in a form suited to the conception of bodies and intervening media, as consisting of parts which act directly on one another only across surfaces of contact.

In the 4th Section Sir J. William Dawson, of Montreal, read a 'Note on Tertiary Fossil Plants from the vicinity of the City of Vancouver, B. C.' This important paper related to a series of beds holding lignite and vegetable fossils and estimated at 3,000 feet or more in thickness and oc-

curring in the southern part of British Columbia, between Burrard Inlet and the United States boundary. These beds, which have been noticed in the Reports of the Geological Survey by Dr. G. M. Dawson and the late Mr. Richardson, are believed to be newer than the Cretaceous coal-measures of Nanaimo and Comox, and probably equivalent to the 'Puget group' of the United States geologists in the State of Washington. Collections of the fossil plants have been made at various times by officers of the Geological Survey, and more recently by Mr. G. F. Monckton, of Vancouver, who placed his material in the hands of the author, along with that previously entrusted to him by the Geological Survey. The species contained in the several collections are mentioned in the paper, and are compared with those of the Puget group, as described by Newberry and Lesquereux, and with those of other localities in British Columbia and the United States. The conclusion as to the age of the flora is similar to that arrived at by Newberry for the Puget flora, making it equivalent to the Upper Laramie or Fort Union group. It thus intervenes in date between the Upper Cretaceous of Nanaimo and the Oligocene or Lower Miocene of the Similkameen district, and is therefore of Eocene age, filling a gap hitherto existing in the mesozoic flora of the West coast. Much, according to Sir W. Dawson, still remains to be known of this interesting flora, and as the formation containing it, which seems to be estuarine in character, extends over a wide area in British Columbia and Washington, and is of considerable thickness, more especially in its extension south of the Canadian boundary, it may ultimately be shown to include several sub-divisions representing the long interval between the Cretaceous and the Middle Tertiary.

Mr. J. F. Whiteaves, paleontologist of the Geological Survey, Ottawa, read an in-

teresting 'Note on the occurrence of *Primnoa Reseda* on the coast of British Columbia.' The main value of Mr. Whiteaves' paper lies in the fact that *Primnoa Reseda* (a tree-like Alcyonarian coral), though known for over a century as occurring in the Atlantic, has not hitherto been with certainty assigned a Pacific habitat. Dr. R. W. Ells and Mr. A. E. Barlow presented a joint paper on 'The Geology of the proposed Ottawa Ship Canal,' the route of which is of unusual interest from a geological, as well as historical and commercial, point of view. A contribution to the history of botanical research on this continent was offered by Prof. (Mgr.) Laflamme, of Laval University, who seeks an answer to the question, 'Where did J. Cornut, who published his *Canadensium Plantarum Historia* in 1635, obtain the specimens from which he wrote his descriptions, and by whom were they transported to Europe?' Mr. G. U. Hay discussed 'some variations in *Epigaea repens*.' Dr. G. F. Matthew, of St. John, New Brunswick, continued a series of studies on the organic remains of the Little River Group in that province. Dr. Wesley Mills (McGill College) presented a series of papers embracing results of investigations into the psychology of the dog, the cat, the rabbit, the guinea pig and certain birds, with corresponding physical indications. The papers also compared the mongrel with the pure-bred dog; the dog with the cat, the rabbit with the guinea pig, etc. These inquiries were conducted with extreme care with the aid of the best equipment for observation and experiment.

One of most important of the scientific papers contributed to the Society was presented, not in section, but before a public audience. Prof. John Cox, M. A. (Cantab), late fellow of Trinity College, Cambridge, and William C. McDonald Professor of Experimental Physics in McGill University, Montreal, had been asked to give a

public lecture on Thursday evening the 16th inst., in connection with the Royal Society's meeting. Prof. Cox has a gift too rare with men of science, and most precious to him whose chosen path of research leads him into *selve obscure* of abstruse problems where for the many no light shines—the gift of clear and eloquent exposition. His subject was 'Unsolved Problems in The Manufacture of Light,' and, in order to illustrate it worthily, he had brought with him from Montreal the admirable apparatus of his laboratory necessary for a series of experiments and lantern views. He was assisted by Messrs Barnes and Pitcher, and the large and cultivated audience gathered in the hall of the Normal School listened enraptured as he made plain mysteries that most of them had regarded as impenetrable. After referring to the time-honored sources of light—the candle, oil lamp, gas, Auer light, and the lime light—and showing that each consisted in heating something till it was incandescent, the lecturer pointed out that none of these gave an efficiency of more than one per cent., the only scientific systems of combustion being the Auer light and lime light. The modern method of electric lighting dated from Sir Humphrey Davy's first production of the arc, with a battery of 2,000 cells. The current thus produced was still ample to heat refractory substances to incandescence, but as zinc and acid were many times as expensive as coal and air the light could not come into practical use until the invention of the dynamo forty years afterward. With the dynamo the modern system was completed, and consisted of three stages—the steam-engine, the dynamo and the lamp. The purpose of the lecture was to show that in the steam-engine and the lamp there is still an enormous waste. After pointing out that light was not created but was produced by the conversion of energy, and explaining the nature of energy as stored up in coal, Prof.

Cox dealt with the three stages in detail. "The conversion of the coal-energy into the mechanical energy," he said, "is of course effected by the steam-engine, but in practice not more than from 7 to 16 per cent. of the energy stored in the coal can be extracted by the steam-engine, and theoretical considerations fix an absolute limit to the perfection of the steam-engine, showing that we can never hope to convert so much as 30 per cent. of the energy of coal by any form of heat-engine. This is one unsolved problem in the manufacture of light—unsolved but still capable of solution if some means of extracting energy from coal otherwise than by heat, and more like the methods used in burning zinc in a battery, can be discovered. At present we are recklessly wasting our coal supplies, and posterity will have a serious grievance against us for squandering these priceless stores."

In the second stage of the process, the dynamo, though so recently invented, is already nearly perfect, and scarcely any energy is lost in its conversion by the dynamo into an electrical current. We reach the third stage, that is, the lamp, with some 7 per cent. of the original energy still available. The lecturer here showed a number of interesting experiments to prove that the only form of energy useful in producing vision consisted of a short series of very minute waves, ranging from the forty-thousandth to the sixty-thousandth of an inch in length, and that to produce these our only means at present was to heat the molecules of some substance, whereby we were compelled to waste the greater part of our efforts in producing heat, which was worse than useless, before we obtained the luminous rays. "Here then," said Professor Cox, "is the second unsolved problem, since even in the incandescent lamp and the arc lamp not more than from three to five per cent. of the energy supplied is converted into light. Thus, of the original

store in the coal less than three parts in a thousand ultimately become useful. In the last six years, however, some hint of means to overcome this difficulty has been obtained from the proof by Maxwell and Hertz that light is only an electric radiation. Could we produce electric oscillations of a sufficient rapidity we might discard the molecules of matter and directly manufacture light without their intervention. To effect this we must be able to produce oscillations at the rate of five hundred billions per second. Tesla has produced them in thousands and millions per second, and Crookes has shown how by means of high vacua to raise many bodies to brilliant fluorescence at a small expense of energy." Illustrations of these processes having been given, the lecturer concluded: "These are hints toward a solution of the problem, but give no solution as yet. Professor Langley states that the Cuban firefly spends the whole of its energy upon the visual rays without wasting any upon heat, and is some four hundred times more efficient as a light producer than the electric arc, and even ten times more efficient than the sun in this respect. Thus while at present we have no solution of these important problems we have reason to hope that in the not distant future one may be obtained, and the human inventor may not be put to shame by his insect rival."

At the general final meeting on Friday (17th inst) it was moved by Dr. Sandford Fleming, C. M. G., of Ottawa, and seconded by Sir William Dawson, F. R. S., that the Royal Society of Canada was of opinion that it is in the interests of science and seamen in all parts of the world that a final determination be speedily reached regarding the unification of the nautical, astronomical and civil days, so that all may begin everywhere at midnight, and that as the proposal can with least difficulty be carried into effect on January 1st, 1901, the Council

be requested in the name and on behalf of the Society to adopt such measures as may be considered expedient to bring about the desired result. This is a subject to which Dr. Sandford Fleming has devoted much and fruitful attention.

The following officers were elected for the ensuing year: President, Dr. R. S. C. Selwyn, C. M. G., F. R. S., ex-Director of the Geological and Natural History Survey; Vice-President, the Archbishop of Halifax, Dr. O'Brien; Secretary, Dr. J. G. Bourinot, C. M. G.; Treasurer, Prof. J. Fletcher. Prof. Bovey, Dean of the Faculty of Applied Science, McGill University, was chosen president of the third section; Prof. Dupuis, of Queen's College, Kingston, Ont., Vice-President, and Capt. E. Deville, Surveyor-General of the Dominion, Secretary. In the fourth section, the following choice was made: President, Prof. Wesley Mills, M. A., M. D., McGill University; Vice-President, Prof. Penhallow, B. Sc., of the same institution; Secretary, Dr. Burgess, Superintendent of the Protestant Insane Asylum, Verdun, near Montreal. J. T. C.

CORRESPONDENCE.

VOLCANIC DUST IN UTAH AND COLORADO.

SCIENCE of April 26th contains an article by H. W. Turner, of Washington, D. C., upon '*Volcanic Dust in Texas.*' It may perhaps be of interest to some of the readers of SCIENCE to learn that large deposits of volcanic dust occur in Utah, and also in the extreme northwestern portion of Colorado. In the year 1890, while I was a professor in the University of Utah, my attention was called to an extensive deposit of a grayish-white substance near Stockton in the Oquirrh range of mountains, some sixty miles southwest of Salt Lake City, by Mr. Ben Johnson of that place. Upon examination I found it to consist almost wholly of microscopic, transparent, siliceous flakes of various, irregular forms, one of the most common be-

ing curved and nearly triangular. When put into pure water, it invariably showed a slight acidity, reddening blue litmus paper. It can be taken from the deposit in lumps; but they readily fall to powder, the particles or flakes becoming separated by the pressure of one's hand. During a tour through southern Utah in the year 1893 I found another large deposit of the same kind of volcanic product on the east side of the Wasatch Mountains in the vicinity of Monroe village, in Sevier county. I could find no difference between this latter and that which occurs near Stockton. Both give a slight acid reaction, which, I suspect to be due to a sulphur compound.

In the same year, 1893, there was brought to me a good sample of grayish white, stratified mineral substance, said to be kaolinite and to have been taken from an immense deposit of a similar character east of Green River and in northwestern Colorado. This so-called 'kaolinite' proved upon examination to be similar volcanic dust, which had been subjected to the action of water mixed with clay, deposited in layers under the water, and afterwards hardened.

HENRY MONTGOMERY.

TRINITY UNIVERSITY, TORONTO.

VOLCANIC DUST IN TEXAS.

UNDER the above title Mr. H. W. Turner contributes an article to *SCIENCE* of April 26, 1895, briefly describing a specimen from the Llano Estacado region. Some of the previous notices of this or similar material are noted below.

The first specimen of the material which came under my notice was received by the Texas Survey in February, 1890, with other material forwarded by Professor W. F. Cummins. It was collected from the beds to which he gave the name 'Blanco Canyon' from the place of their most characteristic development, and in his first de-

scription of them* he calls it chalk. Later, microscopic slides of this material were prepared in the Survey laboratory, by Mr. J. S. Stone, under the direction of Professor R. T. Hill, and these exhibited a large number of very finely preserved diatoms.

These diatoms were partially identified by Mr. C. H. Kain and published by Prof. Cope in his first notice of the probable Pliocene age of the Blanco Canyon beds.†

The diatomaceous character of this material was further noted by Messrs. Lewis Woolman and C. Henry Kain, and list of species given in *The American Naturalist* for 1892, p. 505, under the title 'Fresh-Water Diatomaceous Deposit from Staked Plains, Texas.'

In 1892 an examination of this material by the writer showed the presence of volcanic dust, but the diatoms constituted by far the greater part of the mass examined, and it was therefore classed with other materials of a similar kind from the coast region as diatomaceous earth, and only those siliceous deposits of like character which failed to reveal diatoms were classed as volcanic dust and briefly described in the Transactions of the Texas Academy of Science.‡ Further reference to these siliceous deposits are also made by Kennedy in the Fourth Annual Report Geol. Sur. Texas, pp. 20, etc.

The stratigraphic position of the deposit referred to by Mr. Turner has been accurately determined, as will be seen by reference to the different reports of Professor Cummins on northwest Texas and the Llano Estacado. The hill mentioned, on Duck Creek, in Dickens county, is in the type locality of the Blanco Canyon beds, and sections are given of it in the first three

* First Ann. Rep. Geol. Sur. Texas, p. 190.

† Proc. Amer. Phil. Soc., 1892, p. 123.

‡ Vol. I., Part I., 1892. P. 33. 'Volcanic Dust in Texas.'

annual reports of the survey. The fossils of these beds (one of them, a turtle, from the hill in question) were sent Professor Cope, and are described by him in the fourth annual report of the survey. He says: "Its position is between the Loup Fork and *Equus* terranes. The fauna is intermediate and peculiar, as not a single species occurs in it which has been found in terranes prior or subsequent to it in time. The horizon is more nearly and strictly Pliocene than any of the lacustrine terranes hitherto found in the interior of the continent."

E. T. DUMBLE.

ON THE CLASSIFICATION OF SKULLS.

TO THE EDITOR OF SCIENCE: I learn from an article by Dr. Harrison Allen (SCIENCE April 5, 1895) that, in a paper entitled 'Observations on the Cranial Forms of the American Aborigines,' Proceedings of the Academy of Natural Sciences of Philadelphia, 1866, 232, J. Aitkin Meigs classified various types of crania, using nomenclature which in some part coincides with that proposed by me in my new 'Method of Classification of Skulls.'

I am very glad to learn that Meigs distinguished the various forms of human skulls as early as 1866, as I have done twenty-six years later. When two men, at so great a distance in time and space, have conceived a similar idea it is a strong argument that this idea is not a fantastic one.

I first tested my new method in the summer of 1891, examining a large collection of Malanesian skulls, and published my first memoir in the spring of 1892, which was translated into German (*Die Menschen Varietäten in Malanesian*. Archiv. für Anthropologie, XXI., 1892). In the same year, 1892, I had fortunately the opportunity of examining more than 2,200 skulls of the Mediterranean and Russian races, ancient and modern. I then systematized my classification, which was im-

perfect, and distinguished varieties and sub-varieties of human skulls in a systematic catalogue of ancient Russian skulls.

This method has the approval of many Italian anthropologists, a notable exception being Mantegazza, a strange type of man, and of some German anthropologists, as Ranke and Benedict. The French anthropologists are indifferent, but they find the method useful as an analysis of forms.

The memoir of Meigs is not known in Europe. The only work of this author that I possess is the Catalogue of the Specimens contained in the collection of the Academy of Natural Science of Philadelphia, 1857. In view of the notice published by Dr. Allen in SCIENCE, I am anxious to read the work referred to, and I should be much obliged if some American friend will procure a copy for me. I shall be glad to refer to the work of Meigs in a special note. G. SERGI.

UNIVERSITY OF ROME, April 23, 1895.

SCIENTIFIC LITERATURE.

The Geological and Natural History Survey of Minnesota, Volume III., Part I. Paleontology. 4to, 1895, Pp. lxxv., 474. Plates xxxiv.

Considerable activity has been manifested of late in a more careful and systematic study of the invertebrate faunas of the various geological horizons of this country, and several works upon the subject have already been published or are now under preparation. The value of a thorough examination and proper illustration of the faunas of many of our geological divisions will be very great to the stratigraphical geologist, for many problems are now obscure on account of the lack of knowledge of the very criteria most important for correlative purposes.

What is most required in this field is not so much the increase in number of species, although many horizons even in the eastern portion of the country have as yet been but

partially explored, as the thorough revision of the synonymy and geological distribution of the well-known forms described by the earlier paleontologists. At present the confusion is so great in many faunas that it becomes almost a hopeless task for the geologist to use the evidence with any hope of satisfactory results.

It is therefore very gratifying to find that the elaborate volumes upon the geology of Minnesota are to be accompanied by exhaustive reports upon the paleontology of the State. The first of these monographs, constituting Part 1., of Volume III., of the Final Reports, has just appeared and treats chiefly of the Lower Silurian faunas of the southeastern portion of the State.

The introductory chapter consists of an 'Historical sketch of investigation of the Lower Silurian in the Upper Mississippi Valley' and contains a chronological catalogue of the palæontological writings upon this subject, including lists of the species described.

Although the introduction deals only with the Lower Silurian, the first chapter is devoted to the Cretaceous fossil plants, a posthumous publication of Leo Lesquereux. Some twenty-eight species, six of them new, are described, the majority of the forms being also figured. More than half of the determinable species have been found in the States to the west, and the flora as a whole indicates the Dakota group as the geological horizon.

The second chapter deals with the microscopical fauna of the Cretaceous and is chiefly given up to a description of the Foraminifera, most of which are from boulder clay, although regarded as derived originally from the Cretaceous. Thirty species, representing eighteen genera, are determined. The authors are Woodward and Thomas.

The three remaining chapters of the volume are devoted to the fauna of the Lower Silurian, the third and fifth chapters

being by Winchell and Schuchert and dealing with the 'Sponges, Graptolites and Corals' and the 'Brachiopoda.' The authors follow Hinde in placing *Receptaculites* and *Ischadites* among the Hexactinellid sponges, and Ulrich in regarding *Cylindrocoelia* and *Heterospongia* as *Calcispongiæ*. If the latter reference should prove correct it is of interest as the earliest occurrence of representatives of that order. Among the corals a new genus, *Lichenaria*, regarded as related to *Columnaria*, but without septa, is established.

The rich Brachiopod fauna receives very exhaustive treatment, as might be anticipated from so thorough a student of the subject as Mr. Schuchert. Altogether eighty-two species with many varieties are recognized, of which several are new.

The longest chapter in the volume is that upon the Bryozoa by E. O. Ulrich. As a class the fossil Bryozoa are most difficult, and the different attempts at their systematic classification have not been attended hitherto with the most satisfactory results. To the author of the present chapter we are indebted more than to any one else for our knowledge of the Paleozoic representatives of this group. In the classification adopted, however, the reference of the Monticuliporoid forms to the Bryozoa is not in accordance with the more recent conclusions in this line.

The report as a whole is a most valuable contribution to the paleontology of the Upper Mississippi basin, and will supply a distinct want to the invertebrate palæontologist. The State Geologist is deserving of much credit for the admirable manner in which the volume has been brought out, and it is to be hoped that other State Surveys, which pay little attention to the paleontology of their States, may be induced to pursue the same course.

WILLIAM B. CLARK.

JOHNS HOPKINS UNIVERSITY.

Fossil Mammals of the Puerco Beds. By HENRY FAIRFIELD OSBORN and CHARLES EARLE. Bull. American Museum of Natural History. Vol. viii., Art. I. Pp. 1-70.

The Puerco Eocene (or Post-Cretaceous) was discovered and named by Cope in 1880, and up to the present time our knowledge of its very remarkable and interesting fauna has been due almost entirely to his labors. It is a fauna which in many ways is very puzzling and raises many exceedingly difficult problems. To the solution of these problems the admirable work of Osborn and Earle is an important contribution. While adding but few new names to the long list of genera and species already established by Cope, the authors have accomplished what is of far greater value, namely, materially increased our knowledge concerning the structure and systematic relationships of many mammals which had previously been known only from fragmentary remains. In this way the character of the fauna as a whole is set in much clearer light than ever before.

Of the more significant results of this investigation, the following deserve particular mention: (1) The determination of the complete dentition of *Polymastodon*, a representative of the Multituberculata, which was one of the dominant types of Mesozoic mammals. (2) The description of parts of the skeleton of *Indrodon*, showing that it was a true lemuroid, as had been doubtfully surmised before, and the reference of the *Chriacide* to the same group. Cope had referred the genera of this family to the creodonts, an example which I had followed, though expressing the opinion that Chriacus and its allies might eventually prove to be lemuroids. (3) A very welcome contribution to our knowledge of the Puerco creodonts is the description of an excellent skeleton of *Dissacus*, the ancestral form of the *Mesonychidae*. What renders this particularly valuable is the fact that the Bridger genus

Mesonyx is already very completely known, and the comparison of the two forms is very instructive for discerning some of the modes of mammalian development. (4) A nearly complete skull of the primitive tillodont *Onychodectes* is described and has an important bearing upon the early morphology of the mammalian skull. (5) The skull of *Pantolambda*, the forerunner of the coryphodonts, which became so abundant and varied in the succeeding Wasatch time, is for the first time made known. This is one of the most valuable results of the whole investigation. (6) The suggestion originally made by Schlosser, that *Mioclenus* and its allies are ungulates rather than creodonts, is confirmed, and a new family of Condylarthra is established for their reception. (7) The upper teeth of *Protogonodon* are determined and the likeness of its dentition to that of the primitive artiodactyls pointed out.

Of the greatest general interest to both geologists and biologists are the conclusions reached regarding the character of the Puerco fauna as a whole, which is shown to be of a prevailingly Mesozoic type. Only a small fraction of this fauna is ancestral to Wasatch and Bridger types, and of these most do not persist beyond the Eocene, while by far the greater number of Puerco genera die out without leaving any successors behind them. This generalization is of much importance in clearing away certain stratigraphical difficulties. It is hardly an exaggeration to say that the Puerco mammalian fauna differs more from that of the Wasatch than does the latter from the recent fauna. If the Wasatch mammals, as a whole, were derived from those of the Puerco, then we must assume the existence of a long, unrecorded gap between the two formations, an assumption which geological data do not support. When, however, we examine the Wasatch genera which clearly were derived from Puerco ancestors, such as *Coryphodon*, *Pachyana*, *Didymictis*, *Ana-*

codon, etc., we find that the degree of advance displayed by these forms is not so very great and that it does not involve any very long lapse of time. The radical difference between the two faunas consists in the ordinal groups which are present in one and not in the other. Thus the Puerco has neither artiodactyls, perissodactyls nor rodents, while the Wasatch has no Multituberculata and relatively few Condylarthra, and the creodonts of the two formations belong, for the most part, to quite different types. The obvious significance of these facts is that at some time between the Puerco and the Wasatch a great migration of mammals from some other region took place and revolutionized the character of the North American fauna.

A distinction that is likely to be fruitful of important results is Osborn's division of the placental mammals into the Mesoplacentalia, of early and more or less Mesozoic type, and the Cenoplacentalia, characteristic of later Tertiary and recent time. "The difference between these two groups consists mainly in the lower state of evolution and apparent incapacity for higher development exhibited by the Mesoplacentals, in contrast with the capacity for rapid development shown by the Cenoplacentals." It can hardly be right, however, to include the creodonts in the lower group, since they not only underwent a great expansion in the Puerco, but in later times they also gave rise, by independent development along at least three lines, to the true Carnivora. Such a group cannot be fairly charged with 'incapacity for higher development.'

This necessarily brief review cannot do more than indicate the many points of unusual interest in this paper, and must refer to the original those who would learn more of it.

W. B. SCOTT.

PRINCETON COLLEGE.

The Ornithology of Illinois; Descriptive Catalogue. By ROBERT RIDGWAY. Published by authority of the State Legislature. Vol. II. May, 1895. Large 8°, pp. 282, pls. 33.

Ridgway's Ornithology of Illinois has a curious history. It was conceived by the able Director of the Illinois State Laboratory of Natural History, Prof. S. A. Forbes, who twelve years ago asked the leading American ornithologist to undertake its preparation. Mr. Ridgway finished the manuscript early in July, 1885. The first volume was finally printed, but the entire edition, together with the plates and cuts, was destroyed by fire. This was in February, 1887. It was reprinted from proof sheets, and proof of the reprint was not submitted to the author. It was issued in November, 1889.

By a singular fatality, the manuscript of the second volume was consumed in the same fire; and, excepting proof of the first 90 pages, which was preserved, the entire book had to be rewritten. This formidable and disheartening task was accomplished in 1891, and the printed book has just been received (May 7, 1895).

The original plan contemplated two distinct parts: Part I., Descriptive Catalogue, by Robert Ridgway; Part II., Economic Ornithology, by S. A. Forbes. The present volume completes the Descriptive Catalogue, and it is earnestly hoped that the volume on Economic Ornithology will follow; though the labor of preparing such a work is too great to be accomplished in a single lifetime or by a single man.

The first volume is prefaced by an introduction of 35 pages, treating of the physical features of the State, the climate, and characteristic features of the avifauna, and ending with a bibliography. The systematic part begins with a key to the higher groups, which are arranged in the old style, the Thrushes coming first. The orders, fami-

lies and genera are defined, as well as the species. Some of the descriptions are original, but most of them are quoted from 'Baird, Brewer and Ridgway's History of North American Birds', and its continuation, the 'Water Birds of North America,' for which work, as everyone knows, they were originally written by Mr. Ridgway. The general matter is not very full and is frequently quoted from the same work. Unfortunately about two-thirds of the biographical part was omitted because of the necessity of limiting the number of pages. There are numerous quotations from Mr. E. W. Nelson's papers on the birds of Illinois, and a few personal observations by the author, chiefly relating to the Austroriparian fauna of the extreme southern part of the State, where he has done much field work, extending over a long period of years. A novel feature is a synonymy of popular names, given under each species.

The first volume covers 520 pages and is illustrated by 32 plates; the second volume covers 282 pages and has 33 plates. Nearly all the plates in both volumes are from Baird, Brewer and Ridgway, and Ridgway's Manual. Most of those in the second volume were made originally for this work, but owing to delay in publication were first used in the 'Manual.' The great majority are outline figures of heads, wings and feet; but some are shaded cuts of birds. Owing to the destruction of the electros, part of these are process reproductions made from proofs and are poorly printed. The frontispiece is a beautiful colored picture of a Meadowlark in full song, drawn by the author, and of unusual excellence.

In faunal works relating to particular areas it is customary to record somewhat in detail the manner of occurrence of each species, to indicate breeding ranges, time of nesting, dates of migration and so on. Very little information of this kind is to be found in the Ornithology of Illinois. The

work consists mainly of technical descriptions and synonymy, to which is added, under each species, a paragraph or two of general matter which as a rule, excepting the quotations from Nelson, is hardly more pertinent to the State of Illinois than to any other part of America where the bird occurs.

Of 49 species classed by Mr. Ridgway as rare, detailed records of occurrence within the State are given for 36.

Mr. Ridgway states that the intent of the book was "to supply the people of Illinois with an inexpensive work which would enable them to identify the birds they desired to learn the names of, and to acquaint them with their leading characteristics." These primary aims the work certainly has fulfilled.

C. H. M.

Tests of Glow-Lamps: W. E. AYRTON and E. A. MEDLEY. The Philosophical Magazine, May, 1895.

Readers of SCIENCE who are interested in the matter of electric lighting from a practical standpoint will find much that is instructive in this paper recently printed in the Philosophical Magazine and published as a separate. For several years Professor Ayrton has been investigating the question of the economy of incandescent lighting and especially the behaviour of the glow-lamp under continuous use. Some of the earlier results of this investigation have been announced from time to time in the English journals, having been communicated by Professor Ayrton to the Physical Society of London. The present pamphlet contains some additions made in January, 1895, and from these additions it appears that the results previously obtained have not been entirely supported by subsequent tests. The principal result reached in these tests was the rather unexpected fact that the glow-lamps examined appeared to increase in effectiveness during the first 80 or

100 hours of their use. It had been very generally assumed that a glow-lamp was at its best, under fixed conditions of pressure, at the very beginning of its life and that it would deteriorate from that time on. The authors of this paper appear to have found, however, that this is not the case and that, on the contrary, the light is increased from the beginning through a certain considerable part of the life of the lamp, after which it slowly fails. One form in which this conclusion is put is that if a group of glow-lamps, such as were examined in this case, being the Edison-Swan Lamps, marked 100-8 and run at a pressure of 100 volts, be kept continuously in operation by putting in a new lamp of the same character whenever a filament breaks, and never replacing the lamps by new except for a broken filament, the light given out by the group will never be as small as at the beginning. Some reference is made to the probable cause of the rise in candle power by use, and the explanation given a year or two ago by Mr. Howell, at a meeting of the American Institute of Electrical Engineers, *i. e.*, that such a rise in candle power is due to an improvement of the vacuum of the lamp during the early part of its life, is commented upon. Some of the earlier examinations of the increase in candle power and improvement in vacuum by the authors of this paper seem decidedly to confirm this explanation by Mr. Howell; but subsequent tests, referred to in the addition to the paper made in January, 1895, are not so favorable to that hypothesis. The authors suggest that the rise in candle power may possibly have been due to a change in the surface of the filament causing the emissivity for heat to decrease, since that would raise the light emitted, as well as the number of candles per watt; but they declare that they have not yet discovered whether such change in heat-emissivity takes place. The methods of carrying on

the investigation, both electric and photometric, are explained in sufficient detail, and the whole is a valuable contribution to the subject.

T. C. M.

NOTES AND NEWS.

ENTOMOLOGY.

Dr. T. A. CHAPMAN has been publishing in the Entomologists' Record of London, and has now completed, a paper of no great length but of much importance, on the classification of butterflies, based on the structure of the pupæ, and a comparison of the same with the pupæ of the lower lepidopterous families. He places special emphasis on two points hitherto entirely neglected: The relative freedom of motion of the middle joints of the abdomen, and the relation of the parts on the head on dehiscence. His conclusions are that the Papilionidæ (excluding the Pierinæ) are the nearest relatives of the Hesperidæ (which agrees with all latest researches), but further that the Lycænids "should no longer be regarded as in any way intermediate between the Papilionids and Nymphalids; rather should the Lemoniidæ and Lycænidæ be regarded as a branch which developed from the primæval butterfly (above the Hesperids) in one direction, whilst the Papilionids arose and branched to the Pierids and Nymphalids quite independently. Another point is that the Pierid separated from the Papilionid at a very early stage of the evolution of the latter, and that the Nymphalid almost immediately thereafter separated from the Pierid." These conclusions are borne out by many facts in the structure of the other stages and especially render the position of the Libytheinæ less anomalous.

BRUNNER VON WATTENWYL has just published his *Monographie der Pseudophylliden*, the last large group of Orthoptera that has specially needed monographic treat-

ment. The group is essentially a tropical one, unknown in Europe and with only one species (as recognized by Brunner) in the United States—our true *Katydid*. Others will doubtless be found upon our southern borders, for in Mexico, Central America and the Antilles Brunner recognizes 34 genera and 73 species, the larger part of them new. The work, which is published in Vienna in 8°, contains descriptions of 434 species, divided among 122 genera, and is accompanied by a quarto atlas of ten plates.

A NEW QUADRUPLE EXPANSION ENGINE.

MESSRS. HALL AND TREAT announce, in the *Sibley Journal of Engineering* for April, 'A New Quadruple Expansion Engine.' This machine, built for regular working at 500 pounds pressure, and with its boiler, tested to 1300 pounds, has now been in operation in Sibley College, at Cornell University, for many months. It was designed by the authors of the paper, built by them in the shops of the College, and has since been tested under a great variety of conditions. The design was entirely original, although, of course, embodying the principles taught them in their college course, the one being a graduate of '93 and the other of '94, and both now candidates for advanced degrees, the one for a doctor's, the other for the master's, degree in engineering. The valve-gear is new and the invention of the builders of the engine. The proportions of the multiple-cylinder system are those derived by application of their text-book and lecture-room work; and the engine as a whole is a success. The boiler has worked well and economically up to above 600 pounds per square-inch, and its waste heat is utilized in the re-heating apparatus of the engine and so thoroughly as to make the temperature of the chimney very low. The steel for 'running parts' was obtained from the Bethlehem Iron Company and proves to be of very fine quality. Special devices

have been required, in every direction, to make the operation of the machine with such high-pressure steam 'satisfactory and safe. Even the injector was necessarily reconstructed, as no ordinary instrument would force water into the boiler against 600 pounds pressure. The figures reported for economy are something under *ten pounds of steam* per h. p. per hour, and the best conditions of operation are not yet fully identified, though unquestionably corresponding closely with the preliminary computations of the designers. This figure is the lowest yet reported, even for engines of many times the size of that here described. It will require authoritative revision and corroboration; but there seems no reason to doubt its substantial accuracy, as the result of many engine-trials under a great variety of conditions. If thus corroborated, it will stand as the 'record of the world' for the nineteenth century. The thermodynamic consumption of this engine should be about 7 pounds of steam per h. p. per hour, exclusive of all thermal wastes, and this should be approximated much more closely in engines of similar type built on a large scale. The figure attained is extraordinary, and almost incredible, for a model engine such as is described; yet it indicates a waste, by conduction and radiation, after all, of no less than twenty-five per cent. of all heat sent to the machine from its boiler.

PAPERS FOR THE MATHEMATICAL CONGRESS AT KAZÁN.

ON the occasion of the dedication of the Lobachévski monument at Kazán will be held a mathematical congress of a week's duration.

It is very much desired by the management that some papers may be contributed by Americans. As a complete program of the scientific communications to be made in the session will be issued this coming February, it is not too early to solicit Ameri-

can scientists to think of preparing something for this memorable occasion. Dr. G. B. Halsted has been asked by President Vasiliev to act for him in this matter, to correspond on questions of detail with any who hope to attend the Congress in person, to take charge of the communications of those who do not anticipate being present and to guarantee their proper presentation.

THE ROYAL GEOGRAPHICAL SOCIETY.

THE annual award of the honours of the Royal Geographical Society was made on May 14th, as follows: The Founders' medal to Dr. John Murray for his services to physical geography, and especially to oceanography during the last 23 years, and for his work on board the Challenger and as director of the Challenger Commission and editor of the Challenger publications since the death of Sir Wyville Thomson in 1882; the Patrons' medal to the Hon. George Curzon, M. P., (1) for his work on the history, geography, archæology, and politics of Persia, (2) for his subsequent journeys in French Indo-China, which have resulted in further publications of geographical as well as political and general value, and (3) for his journeys in 1894 to the Hindu Kush, the Pamirs and the Oxus, together with his visit to the Ameer of Afghanistan in Kabul; the Murchison grant was awarded to Mr. Eivind Astrup for his remarkable journey with Lieutenant Peary across the interior glacier to the northern shores of Greenland, and for his independent journey along the shores of Melville Bay, during which he laid down a portion of the northern part only previously seen at a great distance; the Back grant was awarded to Captain C. A. Larsen for the geographical and meteorological observations made by him during his Antarctic voyage in 1894; the Gill memorial was awarded to Captain J. W. Pringle, R.

E., for his share in the railway survey operations carried on under the direction of Captain Macdonald, R. E., in the country between the coast from Mombasa to the Victoria Lake; the Cuthbert Peek grant was awarded to Mr. G. F. Scott-Elliot for his explorations of Mount Ruwenzori and the region to the west of the Victoria Nyanza.—*London Times*.

THE NATIONAL GEOGRAPHIC SOCIETY.

THE National Geographic Society of Washington held its annual business meeting on May 31. Reports from the various officers bore witness to the increasing usefulness of the Society. When it was first organized, in 1888, there were but 205 members. Since then there has been a steady increase, the membership now numbering 1,193. A similar increase may be noticed in the number of public lectures delivered; sixty-two lectures having been given during the past winter, while in the winter of 1890 there were but eighteen.

Mr. Gardner G. Hubbard was reëlected President and Lieut. Everett Hayden Recording Secretary, and the following were elected Vice-Presidents: C. W. Dabney, Jr., Assistant Secretary of Agriculture; H. G. Ogden, Coast and Geodetic Survey; Gen. A. W. Greely, Chief Signal Service; C. Hart Merriam, Agricultural Department; W. W. Rockhill, Assistant Secretary of State, and Henry Gannet, Chief Topographer United States Geological Survey; Board of Managers, Marcus Baker, United States Geological Survey; G. K. Gilbert, Chief Geographer, United States Geological Survey; John Hyde, Statistical Expert, Agricultural Department; Prof. W. J. McGee, Bureau of Ethnology; F. H. Newell, Chief Hydrographer, United States Geological Survey; Prof. W. B. Powell and John R. Proctor; Treasurer, C. J. Bell; Recording Secretary, Everett Hayden; Corresponding Secretary, Miss E. R. Scidmore.

BOTANICAL BOOKS AT AUCTION.

AMONG the botanical books in the library of William B. Rudkin sold at auction in New York by Bangs & Co. were the following: H. Baillon's 'Natural History of Plants,' 7 vols., 8vo, brought \$15.87; Bentham and Hooker, 'Genera Plantarum,' London, 1862-83, \$17.25; Bentley and Trimen, 'Medicinal Plants,' 306 colored plates, London, 1880, \$34; Botanical Gazette, 13 vols., Madison, Wis., v. b., \$19.50; Charles Darwin's Works, a rare 'set' of 15 vols., 8vo, uniform green morocco, full gilt, \$41.25; D. C. Eaton, 'Ferns of North America,' colored plates by Emerton and Faxon, Salem, 1879, \$27; Elwes, J. H., 'Genus Lilium,' grand 4to, London, 1880, \$12.50; Emerson, 'Trees of Massachusetts,' 1878, \$8.50; John Gerarde, 'The Herball,' enlarged by Thomas Johnson, London, 1636, \$14.75; Goodale, 'Wild-flowers of America,' Boston, 1882, \$8.25; Lesquereux, 'Coal-Flora of Pennsylvania,' Harrisburg, 1880, \$10; J. C. Loudon, 'Arboretum Britannicum,' London, 1854, \$17; M. T. Masters, 'Vegetable Teratology,' London, 1869, \$8.25; Michaux and Nuttall, 'N. A. Sylva,' 277 colored engravings, 5 v., 8vo, embossed morocco, Philada., 1871, \$51.25; Parkinson, 'Theatrum Botanicum,' 4to, panelled calf, London, 1640, \$16.40; Ch. Pickering, 'Chronological History of Plants,' Boston, 1879, \$6; Powell, 'A Compleat History of Druggs,' London, 1725, \$5.50; Seeman, Berthold, 'Plants of the Fiji Islands,' 100 fine colored plates, London, 1865-73, \$20.50; Sowerby, 'English Botany,' colored figures by Sowerby, Fitch and others, 12 vols., 8vo, \$63; Torrey Botanical Club, various Bulletins, etc., 17 vols., \$26.35.

GENERAL.

At the monthly meeting of the trustees of the University of Pennsylvania the acting provost, Charles C. Harrison, made a donation of \$500,000 to the University, in honor

of his father, the late George L. Harrison, LL. D. Mr. Harrison stipulates that the fund shall be known as 'The George L. Harrison Foundation for the Encouragement of Liberal Studies and the Advancement of Knowledge.' The principal of this fund must be retained intact, the income alone to be used for the purposes of foundation. The following suggestions as to the use of the fund were made by the donor: 1 The establishment of scholarships and fellowships intended solely for men of exceptional ability. 2 The increasing the library of the University, particularly by the acquisition of works of permanent use and of lasting reference, to and by the scholar. 3 The temporary relief from routine work of professors of ability, in order that they may devote themselves to special work. 4 The securing men of distinction to lecture and, for a term, to reside at the University.

ACCORDING to an announcement from Macmillan & Co., the University Press of Columbia College will issue an *Atlas of Fertilization and Karyokinesis*, by Professor Edmund B. Wilson, with the coöperation of Dr. Edward Leaming. The work will contain forty figures, photographed from nature by Dr. Leaming from the preparations of Professor Wilson at an enlargement of one thousand diameters, and reproduced, without retouching or other alterations, by the gelatine process by Bierstadt, of New York. The photographs are very perfect and convey a good idea of the actual object. They illustrate nearly every important step in fertilization, from the first entrance of the spermatozoön onwards to the cleavage-stages, and not only present a very clear picture of the more familiar outlines of the subject, but embody many original discoveries as well. They are accompanied by an explanatory text, comprising a general elementary introduction, a critical description of the plates and a large number of text-cuts.

THE death is announced of Theodor Brorsen, at the age of seventy-six. He discovered at Kiel, on February 26, 1846, the small comet called by his name, which was found to have a period of about $5\frac{1}{2}$ years, and was observed at returns in 1857, 1868, 1873 and 1879, but has not since been seen, though a conjecture has been thrown out that it had some connexion with one discovered by Mr. Denning last year. Brorsen discovered another comet in 1846, a third in 1847, and two more in 1851.

DR. HUGH FRANCIS CLARKE CLEGHORN died at Straththie, in Fife, Scotland, on May 19th. He was appointed Professor of Botany in Madras University in 1852, and was an authority on Indian botany and arboriculture. While in Madras he organized a forest department, having for its object the preservation of tree life, and established an admirable system of management. Dr. Cleghorn returned to Scotland in 1869, filling temporarily the chair of Botany in Glasgow University. He was also president of the Royal Arboricultural Society and an active member of the Edinburgh Botanical Society.

At the commencement exercises of Stanford University, President Jordan stated that Mrs. Stanford had been spending \$1,000 a day of her private fortune to maintain the University. In case Mrs. Stanford's fortune should be exhausted before the decision of the Courts in regard to the Stanford estate had been reached, it would be necessary to close the University.

JOHN PAUL PAULISON died at Tenafly, New Jersey, on May 30th. Mr. Paulison was interested in astronomy and owned a private observatory.

PROFESSOR J. J. STEVENSON, of the University of the City of New York, will spend the summer in the coal fields of Arkansas, Indian Territory and Texas, with incidental studies in New Mexico and Colorado.

DR. ADOLF ELSASS, Professor of Physics in the University of Marburg, died on May 12th, at the age of forty years.

THE June issue of the Amherst Literary Monthly will be a special memorial number devoted to President Seelye.

THE Royal Natural History, edited by Richard Lydekker (reviewed in SCIENCE, April 5, p. 387) is being published in America by Frederick Warne & Co. It will be issued in thirty-six fortnightly numbers and will be completed at the same time as the English edition.

DR. D. K. PEARSON has offered \$50,000 to Mount Holyoke College if an additional \$150,000 can be raised. It is said that Dr. Pearson has already given \$2,000,000 to various colleges.

HAROLD WHITING, Professor of Physics in the University of California, was among those lost in the submergence of the steamship Colima.

At the May meeting of the Victoria Institute, London, the subject of 'Early Man' was considered. In dealing with it the evidence for the existence of a 'missing link' was first examined, the subject being introduced in a paper by Professor E. Hull, late Director-General of the Geological Survey of Ireland. In dealing with it he reviewed all the known instances of so-called 'missing links,' including that discovered by Dr. Dubois in Java, and concluded that none could be regarded as in fact 'a missing link.' After this the question of the earliest man was discussed in a paper by Sir William Dawson, in which he described the physical character and affinities of the Gaunches, an extinct race in the Canary Islands.

MR. W. W. ROCKHILL, Assistant Secretary of State, who has been appointed by the State Department a delegate to the International Geographical Congress, meeting in London this summer, will join with a

delegation from the National Geographic Society in an effort to persuade the Congress to hold its next meeting in Washington.

THE death is announced of Dr. Franz Neumann, the oldest active teacher in Germany. In 1826 he was called to the Professorship of Physics and Mineralogy in the University of Königsberg, and for sixty-nine years has been teaching and working in the same institution. Dr. Neumann was the first man in Germany to teach Mathematical Physics.

IT is stated that Professor E. E. Barnard and Professor Burnham have accepted positions in the Yerkes Observatory, Chicago.

PRINCIPAL PETERSON, who has accepted the Principalship of McGill University, in succession to Sir William Dawson, graduated at Edinburgh University in 1875, and afterwards gained an open scholarship at Corpus Christi College, Oxford. For two and a half years he acted as assistant to the Professor of Humanity in Edinburgh University. On the inauguration of University College, Dundee, in 1882, Mr. Peterson was unanimously appointed Principal and Professor of Classics and Ancient History.

MAJOR WILLIAM A. SHEPARD, for twenty-five years Professor of Chemistry in Randolph Macon College, died in Ashland, Va., on June 3d.

A STATUE of the late Professor Billroth was unveiled in the Hospital Rudolfinerhaus on April 25th.

SOCIETIES AND ACADEMIES.

GEOLOGICAL SOCIETY OF WASHINGTON.

THE following are abstracts of the communications presented at the thirty-fourth meeting, May 8, 1895 :

G. F. BECKER. 'Gold Fields of the Southern Appalachians.' This communication presented a summary of a report upon

these gold fields, based upon field work of the last season, which will appear in the Sixteenth Annual Report of the Director of the U. S. Geological Survey, and will be issued in separate form very soon.

The geographical position, history and statistics of the known deposits were first given, followed by a discussion of the rock formations and the structural features of the regions in which the deposits occur. The gold-bearing veins and impregnations were then described, and a long list of the observed gangue minerals was given, with comments upon their significance. The secondary, or placer deposits, were also considered.

C. WILLARD HAYES. 'Notes on the Geology of the Cartersville Sheet, Georgia.' The region covered by the Cartersville sheet is in northwest Georgia, its northern and western borders being about thirty miles respectively from the Tennessee and Alabama lines. Its topography is dominated by two peneplains, the older preserved by the harder metamorphic and crystalline rocks on the eastern side of the sheet, and the younger developed on comparatively soft limestones and shales. The older peneplain shows a decided southward inclination from an altitude of 1,400 feet at the north edge of the sheet to 1,000 at the south edge. Above the peneplain rise a few monadnocks from 800 to 1,000 feet, while the larger streams have cut their channels several hundred feet deep within it. The lower peneplain has an altitude of between 800 and 900 feet, and a slight inclination toward the west. The two plains probably coincide a short distance east of this region, in the vicinity of Atlanta.

Two distinct groups of rocks are found in this sheet, separated by a profound fault. The rocks west of the fault are unaltered Cambrian and Silurian, while those to the east are crystalline and metamorphic, probably Archean and Algonkian. The most

striking structural feature on the sheet is the Cartersville fault by which the metamorphic rocks are superposed upon the unaltered Paleozoics. In the northern portion of the sheet the fault plane dips eastward at a low angle, in general less than 15° , the Cambrian limestone and shale passing under the black Algonkian slate and conglomerate which lie in open folds to the eastward.

In the vicinity of Cartersville the fault plane dips eastward much more steeply, probably not less than 75° . A short distance east of this portion of the fault is a large mass of granite, probably Archean, to which the change in the character of the fault is doubtless due. While to the north and south of this granite mass the sedimentary rocks were readily moved upon their bedding planes, so that they transgressed a long distance upon the Paleozoics, the absence of planes in the granite retarded movement at this point, causing a deep re-entrant angle in the course of the fault. A further effect of the anchoring of the strata by this granite mass is seen in the abnormal strikes at its northern end. The sedimentary rocks have been carried past it toward the west, so that for a distance of fifteen miles they strike northwest, at right angles to the normal axes of this region.

ALFRED H. BROOKS. 'Notes on the Crystalline Rocks of the Cartersville Sheet, Georgia.' In this paper Mr. Brooks gave petrographical descriptions of the granites, diorite, gabbro and hornblende schist of the Cartersville district.

LESTER F. WARD. 'The Red Hills and Sand Hills of South Carolina.' The speaker considered these well known topographic features of a broad band crossing South Carolina, concerning which various opinions have been held, to be remnants of the Lafayette formation. He described localities where the red and white sands were observed to grade into, or alternate with, each

other as parts of one formation. As this formation overlaps various older beds to the granite, the discovery of Eocene fossils by Tuomey at the base of certain hills may be understood.

The red and white sands are associated with shales and clays, and Professor Ward believed that they were to be considered as a northeastern extension of the 'Red loam' (Lafayette) formation of the Gulf States.

WHITMAN CROSS,
Secretary.

NEW YORK ACADEMY OF SCIENCES.

THE section of geology met on May 20, and listened to the following papers:

J. F. KEMP, 'The Iron-ore Bodies at Mineville, Essex County, N. Y.' The history of iron mining in this district was briefly outlined by the speaker, and the early development of the enormous ore-bodies at Mineville was sketched. Their geological relations were then shown by means of a series of sections, about twenty-five in number, which had been prepared by the engineer of the companies operating the mines, Mr. S. B. McKee, assisted by the speaker. These sections had been drawn under the guidance of Prof. Kemp on panes of thin crystal plate glass about one-eighth inch in thickness and 21x33 inches. The glass is of such transparency that the entire series of sections came out very clearly and showed the relations of the ore-bodies with great vividness. The scale was one inch to the hundred feet, making thus twenty-five vertical sections, one hundred feet apart and extending nearly half a mile. It was at once apparent that Miller Pit, Old Bed, '21,' the Bonanza and the Joker ore-bodies were all really parts of one enormous mass which lies on a pitching anticline. Miller Pit and Old Bed are faulted from each other and from '21.' A trap dike intersects Miller Pit. In the field the relations are very confusing, and it can

not be stated that the model clears them all up, but it shows the broader features admirably and will be later described in greater fullness.

The speaker gave some further details of the geological relations of the ore and the character of the rocks as shown by drill cores. The presence of intruded sheets of gabbro in the gneisses was especially emphasized, and in particular their existence as proved by the cores, immediately beneath some thin beds or veins of ore. The paper was further illustrated by a large series of lantern slides of the mines.

The second paper, by G. van Ingen, on 'The significance of the recent studies of Mr. G. F. Matthew on Cambrian Faunas,' published by the Academy,' covered practically the same ground as did Mr. Matthew's abstract printed in *SCIENCE* April 26, p. 452. Mr. van Ingen added many additional particulars based on his field experience in collecting the fossils, and also exhibited comparative sections of the Cambrian in both Europe and America.

The third paper, by W. D. Matthew, 'The Effusive and Dike Rocks, near St. John, N. B.,' was postponed on account of the lateness of the hour. It appears, however, in full in the Transactions of the Academy, and adds much to our knowledge of the Pre-Cambrian volcanic rocks of New Brunswick.

J. F. KEMP,
Recording Secretary.

SCIENTIFIC JOURNALS.

THE PHYSICAL REVIEW.

Vol. II., No. 6. May-June, 1895.

The Capacity of Electrolytic Condensers: By SAMUEL SHELDON, H. W. LEITCH and A. N. SHAW.

This paper contains a description of experiments performed upon two types of Platinum— H_2SO_4 cells, which, when charged to potentials less than the E. M. F. of polarization, are found to act as con-

densers. The capacity of such condensers is dependent upon the impressed E. M. F. as well as upon the surface and character of the electrodes. By a method quite analogous to the 'ballistic method' of testing iron the authors have shown the presence of a very considerable hysteresis in the relation between potential and charge. The curves showing this relation present in fact a striking resemblance to the ordinary hysteresis loop. Considerable difficulty was met with in reducing the electrodes to an unpolarized condition, even with new specimens of platinum. Here also an application of magnetic methods was found useful, the cells being conveniently depolarized by reversals. The paper contains also an investigation of the effect of temperature and concentration upon the capacity. In spite of the large capacity of electrolytic condensers, the authors are of the opinion that the high temperature coefficient and low efficiency of such cells are prohibitive to practical usage.

Thermal Conductivity of Copper, I. By R. W. QUICK, C. D. CHILD and B. S. LANPHEAR.

In this article is begun the description of observations made to determine the thermal conductivity of a bar of copper intended for use as a standard of length. The method used was that of Forbes. The measurement of the temperature at different points of the bar was made by a method different from that usually employed, and depended upon the variation in the resistance of a coil of fine copper wire, which could be shifted from point to point throughout the length of the bar. Results were obtained for the conductivity through a range of temperatures extending from 74° to 167° , the extreme values being 0.914 at the lower of these two temperatures and 1.024 at the higher. Observations at temperatures below 0° will appear in a subsequent article.

On the Absorption of Certain Crystals in the Infra-red as Dependent Upon the Direction of the Plane of Polarization. By ERNEST MERRITT.

By means of a spectro-bolometer the writer has determined the transmission curves for Quartz, Iceland Spar, and Turmalin out to a wave length of 5.5μ . In order to detect the differences between the absorption of the ordinary and extraordinary rays the radiation used (that of a Zirconium lamp) was polarized by reflection before passing through the crystal specimen. On account of diffuse rays from the surface of the fluorite prism considerable difficulty was met with in obtaining a pure spectrum; a difficulty which was finally met by using two spectrometers 'in series;' *i. e.*, the spectrum formed by one spectrometer was thrown upon the slit of another. The results show that the transmission curves of the ordinary and extraordinary rays are entirely independent in all three cases. In the case of Iceland Spar the differences between the two curves is especially marked, sharp absorption bands being present in the one curve which are entirely absent in the other. At $\lambda = 3.3 \mu$ Iceland Spar is found to behave as turmalin, *i. e.*, the ordinary ray is suppressed, while the extraordinary ray is transmitted in considerable amount. The difference between the two curves is less marked in the case of Quartz, but is very considerable with Turmalin. In the latter case the two curves are found to intersect, and in the region lying between the points of intersection the dechroism of turmalin is reversed.

Resonance in Transformer Circuits. By F. BEDELL and A. C. CREHORE.

In this article the writers discuss the action of a condenser in either circuit of a transformer, and develop by purely graphical methods the conditions necessary for primary resonance due to a secondary condenser, a

phenomenon to which Dr. Pupin has given the name electrical consonance. A primary circuit alone, and with no condenser, would have no natural period of oscillation; but it may have such a period when a neighboring secondary circuit contains a condenser. The elastic influence of the condenser is transferred from one circuit to the other, on account of their mutual relationship; and the natural period of the primary circuit depends not only upon the value of its own constants, but those of the secondary as well. There is a surging of energy back and forth between the primary circuit and the secondary condenser by intervention of their common magnetic field; the period of these surgings determines the period of the system. In addition to the graphical analysis, Drs. Bedell and Crehore subject the problem to a brief analytical treatment leading to identical results. It is shown that there are two values of the capacity of the secondary condenser which will give rise to consonance. It is pointed out that a condenser in the secondary of the transformer may compensate for the drop due to magnetic leakage; in fact, this drop may be over-compensated for, so that the secondary potential will actually rise as the transformer is loaded down.

Aside from the particular conclusions reached, the paper is of interest for the methods employed, the problem in hand illustrating well the writer's method of reciprocal points in constructing admittance and current diagrams from diagrams of impedance and electromotive forces.

On the Secular Motion of a Free Magnetic Needle, I. By L. A. BAUER.

This article forms the introduction to an important paper on the secular variation of terrestrial magnetism which will be concluded in the next number. The present article is devoted to a description of the

methods of accumulating and discussing the available data. An abstract is postponed until the appearance of the remainder of the paper.

New method of Testing the Magnetic Properties of Iron. BY W. S. FRANKLIN.

In determining the curve of magnetization, the sample, in the form of a long narrow Π , is suspended from the arm of a balance, the legs of the Π being surrounded by fixed magnetizing coils. The induction may then be calculated from the weight necessary to hold the specimen in equilibrium. A novel method of determining hysteresis loss is also described. In this case the sample was in the form of a long rod, and was magnetized by a rather short coil. The rod was suspended from one part of a balance, and was weighed first while the coil was moved slowly upward and afterwards during a slow downward motion of the coil. A method is developed by which the hysteresis loss may be computed from the difference of these weights. Experimental data accompany the paper.

New Books. The following books are reviewed: RAYLEIGH. *Theory of Sound, Vol. I.* POINCARÉ. *Les Oscillations Electriques.* CARHART. *University Physics.*

THE JOURNAL OF COMPARATIVE NEUROLOGY.

THE Journal of Comparative Neurology for March contains three original papers. The first, 'Modern Algedonic Theories,' by C. L. Herrick, is a critique based primarily upon Marshall's Pain, Pleasure and Æsthetics, though most of the other recent literature is reviewed in the same connection. The physiological theory of emotion finally adopted by the writer is in the main a composite drawn chiefly from the nutrition theory of Meynert, the discharge theory of Lange and James, and the theory of habit of Gilman. In brief, it is a resistance theory. When we have agreed upon the

nature of the simplest sense, pain and gratification, the foundation will have been laid for the more complex æsthetic phenomena. This foundation is believed to consist in the recognition of a special kind of neurosis for the feelings due to two classes of stimuli of a very similar but not identical kind. Given an excessive stimulus which for whatever reason freely irradiates, and pleasure is felt; given another stimulus, or the same excessive stimulus with other neural conditions which prevent irradiation and produce a summation and overflow, and pain is felt. Emotion consists (1) of general sensations of total, organic or irradiating varieties which have in common a lack of localization and, as a result of associational laws, are amalgamated more or less closely with the empirical ego; (2) of more or less explicate or implicate cognitions (perceptions, intuitions) of the relation between the cause of the sensation and our well-being; (3) the emotion is more or less closely attached to various impulsive expressions which tend in various ways to intensify the two preceding. The psychical element of emotion is essentially intellectual, and the attempt to secure a serial relation of the 'faculties' must be abandoned.

The second paper by M. A. Raffalovich deals with 'Uranism, or Congenital Sexual Inversion.' It is a plea for the early recognition of congenital inversion in children and the proper education of such children. Inversion is no excuse for debauchery and Krafft-Ebbing's pity for the race of inverted persons is largely misplaced. The psychological history of a superior uranist is traced and commented upon at length.

In a brief paper entitled 'The Histogenesis of the Cerebellum,' C. L. Herrick notices the recent work of Dr. Shaper upon the cerebellum of teleosts and calls attention to the gratifying harmony between these results and his own studies published in 1891.